BABENKO, Dem'yan Alekseyevich; TEPLENKO, Sarra Isaakovna; CHIBISHEV, Leonid Dmitriyevich; TSIBULEVSKIY, P.I., red.

[Electrician's manual on the winding of asynchronous electric motors] V pomoshch' elektriku-obmotchiku asinkhronnykh elektrodvigatelei. Moskva, Energiia, 1965. 255 p. (MIRA 18:8)

ZHOLDAK, Sergey Afanas'yevich; RUBO, L.G., retsenzent[deceased];
TSIBULEVSKIY, P.I., red.

[Repair of miniature electric machines of automatic systems] Remont elektricheskikh mikromashin avtomaticheskikh ustroistv. Moskva, Energiia, 1965. 255 p.
(MIRA 18:2)

ANAN'YEV, Yevgeniy Grigor'yevich; KONNIK, L.I., red.; ROZHDESTVENSKIY, V.V., red.; TSIBULIN, L.G., red.; MIKHEYEVA, Z.I., red.

[Under a steel canvas] Pod stal'nym parusom. Tiumen', Tiumenskoe knizhnoe izd-vo, 1963. 207 p. (MIRA 17:9)

BOGOMYAKOV, G.P.; GURARI, F.G.; KAZAKOV, D.Ye.; MIRONOV, Yu.K.; NESTEROV, I.I.; ROZHOK, N.G.; ROVNIN, L.I.; ROSTOVTSEV, N.N.; RUDKEVICH, M.Ya.; TSIBULIN, L.G.; ERV'YE, Yu.G.

Prospecting for oil and gas in the West Siberian Plain. Geol. nefti i gaza 8 no.9:43-48 S '64. (MIRA 17:11)

1. Sibirskiy nauchno-issledovatel'skiy institut geologii, geofiziki i mineral'nogo syr'ya, Tyumenskoye geologicheskoye upravleniye i Novosibirskoye territorial'noye geologicheskoye upravleniye.

TSIBULIN, V.P., inzh.

Improving the durability of the four-row roller chain of the E-505 and E-652 excavators. Stroi. i dor. mash. 9 no.5:18-20 My '64. (MIRA 17:6)

TSIBUL'KIN, V.M. [TSybul'kin, V.M.]; BEL'KEVICH, P.I. [Bial'kevich, P.I.]

Comparative study of the bitumen formers of some plant species and the bitumens of an upland peat layer. Vestsi AN BSSR Ser. fiz.-tekh.. nav. no.1:101-109 '64 (MIRA 17:7)

TSIBUL'SKIY, Ye.

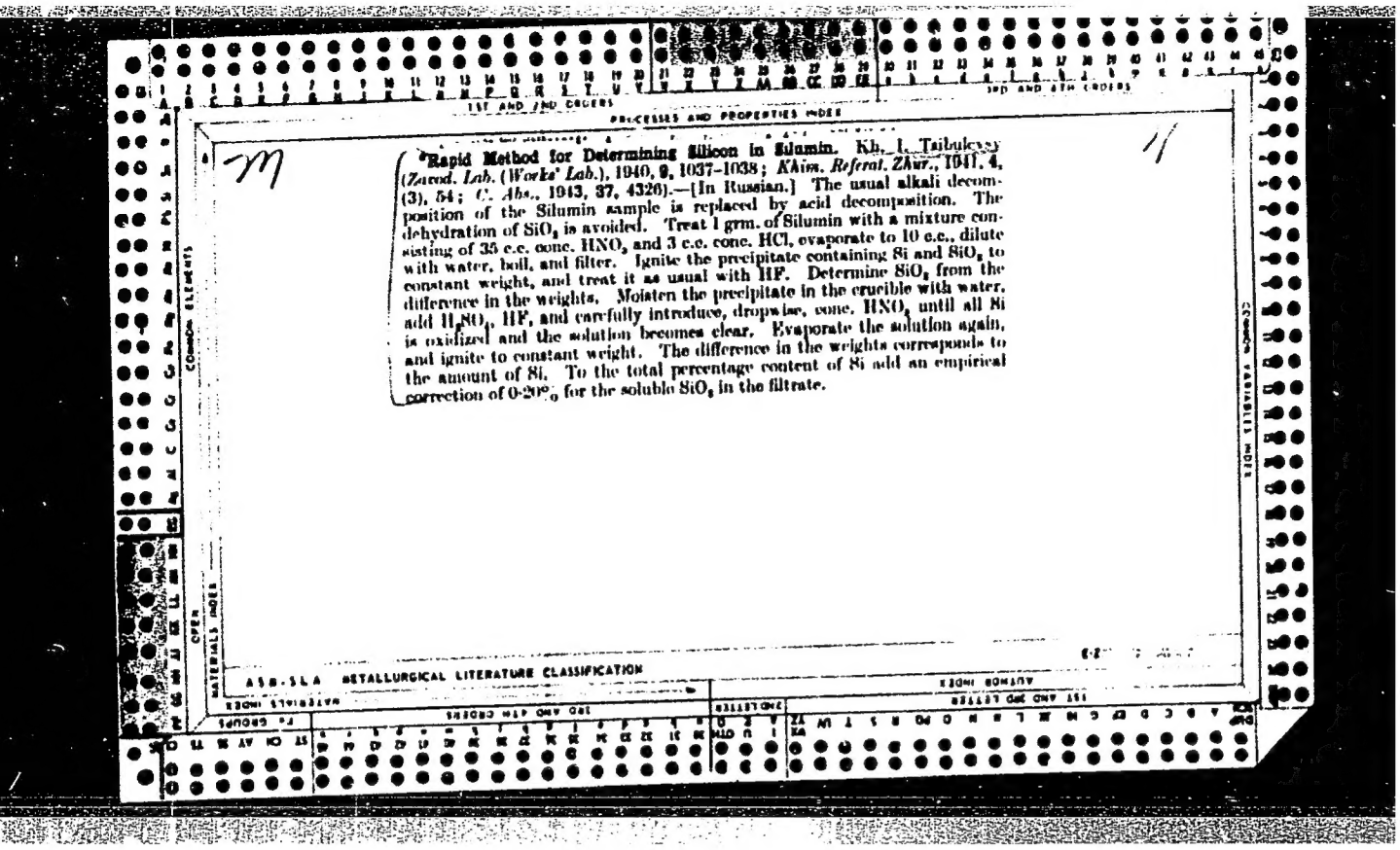
Acquire a deep understanding of science and technology. Radio no.7:4-5 Jl '62. (MIRA 16:6)

1. Zaveduyushchiy sektorom oboronno-massovoy raboty TSentral'nogo komiteta Vsesoyuznogo Leninskogo kommunisticheskogo soyuza molodezhi.
(Communism and science)

A.C.S.

Chemistry + Physics

Rapid method of determining silica in silumin. Kit. I. Tsinman. *Zavodskaya Lab.*, 9 [9] 1037–38 (1940). *Khim. Referat. Zhur.*, 4 [3] 54 (1941).—The silumin is decomposed with acids instead of by the usual alkali decomposition, and the dehydration of SiO_2 is eliminated. Decompose 1 gm. of silumin with a mixture of 35 ml. of 1.2HNO_3 and 3 ml. of 1.19HCl. Evaporate to 10 ml., dilute with water, boil, and filter. The residue contains Si and SiO_2; ignite it to constant weight and treat with HF as usual. The difference in weight gives SiO_2. Wet the residue with a little water and add H_2SO_4, HF, and 1.4HNO_3 dropwise to complete the oxidation of Si and until the solution becomes clear. Concentrate and ignite to constant weight as before. The difference in weight is Si. To the combined value of Si add an empirical correction of 0.20% for the SiO_2 lost in the filtrate. M.Ho.



Rapid Method for Determining Silicon in Silumin. Kh. I. Taibulcev (*Zavod. Lab.* (*Works' Lab.*), 1940, **9**, 1037–1038; *KAim. Referat. ZAur.*, 1941, **4**, (3), 54; *C. Abs.*, 1943, **37**, 4326).—[In Russian.] The usual alkali decomposition of the Silumin sample is replaced by acid decomposition. The dehydration of SiO_2 is avoided. Treat 1 grm. of Silumin with a mixture consisting of 35 c.c. conc. HNO_3 and 3 c.c. conc. HCl, evaporate to 10 c.c., dilute with water, boil, and filter. Ignite the precipitate containing Si and SiO_2 to constant weight, and treat it as usual with HF. Determine SiO_2 from the difference in the weights. Moisten the precipitate in the crucible with water, add H_2SO_4, HF, and carefully introduce, dropwise, conc. HNO_3 until all Si is oxidized and the solution becomes clear. Evaporate the solution again, and ignite to constant weight. The difference in the weights corresponds to the amount of Si. To the total percentage content of Si add an empirical correction of 0-20% for the soluble SiO_2 in the filtrate.

KLYUSHKIN, A.N.; TSIBULIN, I.M.

Seeded pastures in Kirghizistan. Zemledelie 27 no.2:47-49 F '65.
(MIRA 18:4)

TSIBULIN, P., inzh. (Alma-Ata)

Who is best? Mest. prom. i khud. promys. 3 no.8:33 Ag '62.
(MIRA 15:10)

(Kazakhstan—Efficiency, Industrial)

SOV/24-58-9-1/31

AUTHORS: Dolezhil, M., Konopleva, N.K., Plaksin, I.N. and Tsibul'ka, Ya. (Moscow)

TITLE: The Effect of Various Flotation Reagents on the Interaction Between Potassium Xanthogenate and Chalcopyrite, Pyrite and Tetrahedrite (O vliyanii flotatsionnykh reagentov-regulyatorov na vzaimodeystviye ksantogenata s khal'-piritom, piritom i tetraedritom)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk, 1958, Nr 9, pp 3 - 8 (USSR)

ABSTRACT: Almost all the copper-bearing ores from deposits in Western Czechoslovakia contain mainly chalcopyrite and tetrahedrite, with a small proportion of pyrite and (sometimes) pyrrhotite. Of these, tetrahedrite is of particular interest since it contains both copper and antimony, the latter element being sometimes replaced by silver and accompanied by mercury. Flotation is a convenient method for treating these ores but it produces a composite sulphide concentrate in which tetrahedrite and chalcopyrite are present in approx, equal proportion, with the result that the concentration of antimony and mercury in the concentrate is approx. 50% lower than in tetrahedrite. This comparatively low concentration of Sb and Hg

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The Effect of Various Flotation Reagents on the Interaction Between Potassium Xanthogenate and Chalcopyrite, Pyrite and Tetrahedrite.

makes extraction of these two metals by pyrometallurgical processes more difficult and the object of the present investigation was to explore the possibilities of selective separation of tetrahedrite, chalcopyrite and pyrite by the flotation method. To this end, the effect of various factors on adsorption and desorption of potassium ethylxanthogenate (KEKH) on the investigated minerals was studied by the radioactive tracer technique. The experimental samples (97.9 - 99.36% purity, 0.06 - 0.15 mm particle size) were washed in distilled water, dried in a vacuum dessicator and stored in evacuated ampoules. The KEKH solution was prepared from solid KEKH containing the radioactive isotope S^{35} (specific activity 315 mc/g). Two solutions were used with the concentration of KEKH equal 3.12×10^{-4} and 1.87×10^{-4} mol/l, corresponding to the consumption of KEKH of 300 and 180 g/t, respectively. The pH number of the solutions was adjusted by addition of HCl or NaOH and the effect of pH on the adsorption of KEKH by

The Effect of Various Flotation Reagents on the Interaction Between Potassium Xanthogenate and Chalcopyrite, Pyrite and Tetrahedrite

the investigated minerals was studied in the following way: 1 g of each mineral with 6 ml of the KEKH solution was stirred mechanically for 15 minutes, filtered, washed with 5 ml of distilled water and dried. The quantity of the adsorbed KEKH was determined from the radioactivity of the powder, and from the difference in the activity of the solution before and after the experiments. The results are reproduced graphically in Figure 1 (for pyrite) and Figure 2 (for tetrahedrite and chalcopyrite). In all cases the relationship between the quantity of adsorbed KEKH and pH number was quite complex with a sharp maximum at pH = 6-6.5 in the case of pyrite and at pH = 5.5-6.5 in the case of the two other minerals. In the next stage, the effect of several reagents on adsorption of KEKH was investigated by measuring the quantity of KEKH adsorbed by powdered minerals that had been previously washed in solutions containing $1 \times 10^{-4} - 3 \times 10^{-4}$ mol/l of the reagents in 6 ml of the solution. The following results were obtained:

The Effect of Various Flotation Reagents on the Interaction Between Potassium Xanthogenate and Chalcopyrite, Pyrite and Tetrahedrite

Pyrite: Adsorption of KEKH decreased by: $K_3Fe(CN)_6$ > > $K_4Fe(CN)_6$ > CaO > $FeSO_4$ > $ZnSO_4$ > Na_2SO_2 > Na_2SO_3 ; adsorption not affected by : Na_2SO_3, NaCl, NH_4CNS ; adsorption increased by : $CaCl_2$ < $CuSO_4$

Chalcopyrite: adsorption decreased by: $K_4Fe(CN)_6$ > CaO > > $Na_2S_2O_3$ > NH_4CNS ; adsorption not affected by : NaCl, Na_2SO_3, Na_2SO_4 ; adsorption increased by : $CaCl_2$ < $ZnSO_4$ < $FeSO_4$ < $K_3Fe(CN)_6$ < $CuSO_4$.

Tetrahedrite: adsorption decreased by : $K_3Fe(CN)_6$ > > $K_4Fe(CN)_6$ > CaO > $FeSO_4$ > $ZnSO_4$ > $Na_2S_2O_3$;adsorption not affected by: Na_2SO_3, Na_2SO_4, $CaCl_2$, NaCl, NH_4CNS; Adsorption increased by $CuSO_4$.

Finally, desorption of KEKH from the investigated substances by means of potassium sulphide was studied. The effectiveness of this desorbent was found to be roughly the same for all three minerals (Figure 6): with the

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The Effect of Various Flotation Reagents on the Interaction Between Potassium Xanthogenate and Chalcopyrite, Pyrite and Tetrahedrite

increasing concentration of Na_2S the quantity of desorbed KEKH increased, reaching 80-95% at 0.5% Na_2S.

It was concluded that selective separation of pyrite, chalcopyrite and tetrahedrite by means of adjusting the pH number of the flotation medium is not possible. The fact that adsorption of KEKH is increased by $K_3Fe(CN)_6$ in the case of chalcopyrite and decreased in the case of tetrahedrite could be utilised for developing a selective flotation process for these two minerals. Alternatively, a solution of Na_2S could be used for removing the adsorbed KEKH from all the three minerals which then could be separated by flotation using suitable activating or depressing reagents. There are 6 figures, 1 table and 3 Soviet references.

SUBMITTED: October 17, 1957

ABKIN, D.E.; TSIBUL'KIN, E.K.

Chyloperitoneum and chylous peritonitis in children. Klin. khir. no.3:42-46 '65. (MIRA 18:8)

1. Khirurgicheskiye otdeleniya Detskoy bol'nitsy imeni Raukhfusa (zav. - kand. med. nauk D.S.Avidon i V.M.Solovskaya) i kafedra khirurgii detskogo vozrasta (zav. - prof. G.A.Bairov) Leningradskogo pediatricheskogo meditsinskogo instituta.

Country : USSR Q
CATEGORY : Farm Animals. Swine

ABS. JOUR. : RZBiol., No. 13, 1958, No. 59565

AUTHOR : Tsibul'ko, V. D.
INST. : -
TITLE : Prolificacy of Sows of the Berkshire Breed in Relation to the Conditions of Feeding

ORIG. PUB. : Sots. tvarinnitstvo, 1957, No 4, 55-56

ABSTRACT : Forty gilts of the Berkshire breed, aged 145 days, were divided into three groups. The diet levels in all three groups were identical. During the trial period, pigs of the 1st group received (as measured by nutritional value): concentrates 95%, succulents 3%, roughages 2%; the 2nd group was fed 75, 15 and 10%, respectively; the 3rd group received 51, 35 and 10%, correspondingly. Development was worst among pigs of the 3rd

CARD: 1/3

COUNTRY : USSR Q
CATEGORY : Farm Animals. Swine

ABS. JOUR. : RZBiol., No. 13, 1958, No. 59565

AUTHOR :
INST. :
TITLE :

ORIG. PUB. :

ABSTRACT cont'd. : group. Daily weight gains in the 1st group averaged 454 g., in the 2nd group 445 g. and in the 3rd group 376 g. The outlay of feedstuffs per 1 kg. of weight gain was 5.7, 5.7 and 6.2 feed units, respectively. The weight, length and volume of the gastrointestinal tract of young hogs in the 2nd and 3rd group were considerably higher than in the 1st group. A difference was also noted in the

CARD: 2/3

Q - 56

Q

Country : USSR
CATEGORY : Farm Animals. Swine

ABS. JOUR. : RZBiol., No. 13, 1958, No. 59565

AUTHOR :
INST. :
TITLE :

ORIG. PUB. :

ABSTRACT cont'd. : generative function of the sows' ovaries: the highest number of ripened and burst follicles was found in the 2nd group; in this group, already on the 75th day of pregnancy, the highest number of live embryos could be observed. The fecundity of sows of the 1st group was 9.2, that of the 2nd group 9.4, and that of the 3rd group 6.7 pigs. In the last group, 39.1% of embryos perished in a later period when the requirement in nutrients increased.-- O. I. Myagkova

CARD: 3/3

- TSIBUL'SKAYA, N. P.

USSR / General and Specialized Zoology. Insects. P
Insect and Mite Pests.

Abs Jour : Ref Zhur - Biol., No 10, 1958, No 44851

Author : Tsibul'skaya, N. P.
Inst : AS UkrSSR
Title : Toxicological Evaluation of a New Organic Phosphorus Insecticide "K-20-35".

Orig Pub : Dopovidi AN UkrSSR, 1956, No. 6, 602-605.

Abstract : Field experiments in spraying sugar-beet sprouts with 0.3 and 1% solutions of the new preparation "K-20-35" (dimethyl ether methylurethane-phosphoric acid) at the rate of 400 litres/ha caused the total destruction of the beet weevils on the 8th and 6th day respectively. The new insecticide equals HCCH with a 6% gamma-isomer in effectiveness, but is more effective than the

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USSR / General and Specialized Zoology. Insects. P
Insect and Mite Pests.

Abs Jour : Ref Zhur - Biol., No 10, 1958, No 44351

standard 10-12% HCCH. The beetles that fed on leaves treated with K-20-35 perished within 2 - 3 hours. The preparation remained toxic on the sprayed sections for 10 days. The preparation did not lose its effectiveness after rain, possibly because the poison penetrated the plant, confirmed by the death of the beetles fed on the cotyledons of the plants when the soil was sprayed with a K-20-36 solution. -- V. T. Gubina.

Card 2/2

Tsibul'skii, N. P.

"Toxicological Evaluation of the New Organophosphorus Insecticide K-20-35," by N. P. Tsibul'ska, Institute of Entomology and Phytopathology, Academy of Sciences Ukraine SSR, Dopovidi Akademii Nauk Ukrainskoy RSR, Kiev, No 6, 1956, pp 603-605

Preparation K-20-35, a dimethyl ester of methylurethanphosphoric acid, is an organophosphorus insecticide synthesized by A. V. Kirsanov. It is odorless, hygroscopic, and dissolves in water at ordinary temperature. K-20-35 is toxic to the sugar beet snout beetle and the larva of the sugar beet fly. When applied to the plants in one percent solution it kills about 95.7 percent of the snout beetles and about 66.7 percent of the larva of the sugar beet fly. A 4 percent solution of the chemical kills almost 100 percent of the larva of the fly. The toxicity of the insecticide when sprayed on the plants lasts up to 10 days. When a solution of the insecticide is used to irrigate the plants the chemical is absorbed by the plant through its roots, permitting the assumption that K-20-35 is a systemic poison.

Sum. 1287

TSIBUL'S'KA, N.P.

Toxicological evaluation of the new "K-20-35" organic phosphorus insecticide. Dop.AN URSR no.6:602-605 '56. (MLRA 10:2)

1. Institut entomologii ta fitopatologii AN URSR. Predstaviv akademik AN URSR P.A.Vlasyuk.
(Insecticides)

GOLYSHEVA, M.G.; GRISHANKOVA, Ye.V.; USPENSKAYA, V.E.; TSIBUL'SKAYA, M.I.; GOFMAN, L.Kh.; VASINA, T.A.

Preservation of Eremothecium ashbyii in active state. Mikrobiologiia 34 no.4:661-665 Jl-Ag '65. (MIRA 18:10)

1. Vsesoyuznyy nauchno-issledovatel'skiy vitaminnyy institut.

Q-2

USSR/Farm Animals - Cattle.

Abs Jour : Ref Zhur - Biol., No 1, 1959, 2640

Author : Konstantinova, L.B., Tsibul'skiy, F.P.
Inst : -
Title : Red Polish Cattle and Ways of Improving It.

Orig Pub : Sots. tvarinnitstvo, 1957, No 3, 28-31.

Abstract : In 1954 in the Volynskaya Oblast of the Ukrainian SSR there was established a State breeding farm for Red Polish cattle. In 1956, within the zone activity of that farm, the milk yield per foraging cow after the 3rd lactation amounted to 2,406 kg of milk with a fat content of 3.83%. The champion cows yielded up to 5,000 kg. of milk. On the slaughter of cows with above average fattening of the body, the slaughter yield amounted to 50.1%, and for cows with average fattening of body, 47.2%. The beef yield accounted for 69.5% of the total weight of the carcass. The beef was succulent and tasty.

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USSR/Farm Animals - Cattle. Q-2

Abs Jour : Ref Zhur - Biol., No 1, 1959, 2640

The disadvantage of this breed is low live weight - adult cows weight 407 kg on the average. In connection with the shortage of valuable sires, it is recommended that bulls or semen be imported to artificial insemination stations from the Polish People's Republic, and also that bulls of the Brown Latvian and Red Danish breeds be utilized. -- O.I. Myagkova

Card 2/2

ASTAF'YEV, K.V.; KAZANTSEV, G.V.; TSIBUL'SKIY, K.I.; SHCHERBOV, D.P.; SHMANENKOV, I.V., redaktor; SERGEYEVA, N.A.; BORISOV, A.S., tekhnicheskiy redaktor

[Team and continuous work methods in chemical laboratories] Brigadno-potochnyi metod raboty v khimicheskikh laboratoriiakh. Trudy lab.geol.upr. no.2:3-47 '52. (MLRA 7:11)
(Chemical laboratories)

ARKHIPOV, P.P., inzhener; IVANOV, Ye.D., inzhener; KRYLOV, N.V., inzhener-arkhitektor; NIKANDROV, B.I., inzhener-arkhitektor; NOSKOV, B.G., inzhener-arkhitektor; RYABTSEV, M.N., vetvrach; SOKHRANICHEV, N.S., inzhener-arkhitektor; TSIBUL'SKIY, L.A., kandidat sel'skokhozyaystvennykh nauk; PIOTROVSKIY, M.I., inzhener, retsenzent; VOL'FOVSKAYA, V.N., redaktor; FEDOTOVA, A.F., tekhnicheskiy redaktor.

[Handbook on the construction of farm buildings] Spravochnik po sel'skokhoziaistvennomu stroitel'stvu. Moskva, Gos. izd-vo selkhoz. lit-ry. Vol. 2. 1952. 579 p. (MLRA 8:2)
(Farm buildings) (Building)

USSR/Cultivated Plants - Commercial. Oil-Bearing. Sugar-Bearing. M-5

Abs Jour : Ref Zhur - Biol., No 7, 1958, 29881

Author : Tsibul'skiy, V.F.
Inst :
Title : Methods of Applying Fertilizers in Side-Dressings to Cotton.

Orig Pub : Sb. kh. Trukmenistana, 1957, No 3, 30-33.

Abstract : No abstract.

Card 1/1

USSR / Cultivated Plants. Commercial. Oil-Bearing. Sugar Bearing. M-5

Abs Jour: Ref Zhur-Biol., No 6, 1958, 25131

Author : Tsibul'skiy, V.F.,
Inst : Not given
Title : The Use of Marked Atoms to Found the Methods of Phosphorus Side-Dressing in Cotton

Orig Pub: UzSSR Fanlar akad. dokladlari. Dokl. AN UzSSR, 1957, No 6, 49-52 (res. Uzbek)

Abstract: No abstract.

Card 1/1

TSIBUL'SKII, V.A.

The Explosives Expert (Sverdlovsk) -
Moscow, 1942.

TSIBUL'SKIY, V.F.

Tagged atom technique to study the effect of phosphorus fertilizers in a cotton field. Dokl. AN Uz. SSR no.6:49-52 '57. (MIRA 11:5)

1. TSentral'naya stantsiya udobreniy i agropochvovedeniya Vsesoyuznogo nauchno-issledovatel'skogo instituta khlopkovodstva. Predstavleno chlenom-korrespondentom AN UzSSR V.Ye. Yeremenko.
(Phosphates) (Phosphorus--Isotopes)

TSIBUL'SKIY, V. F., Cand Agr Sci -- (diss) "Methods of introduction of phosphorus fertilizers in supplements during lengthwise-diagonal processing of the cotton plant." Tashkent, 1960. 15 pp; (State Committee of Higher and Secondary Specialist Education of the Council of Ministers Uzbek SSR, Tashkent Agricultural Inst); 300 copies; price not given; (KL, 28-60, 163)

PASECHNIK, I.P.; KOGAN, S.D.; SULTANOV, D.D.; TSIBUL'SKIY, V.I.

Results of seismic observations during underground nuclear and trotyl explosions. Trudy Inst. fiz. Zem no.15:3-52 '60. (MIRA 14:3)
(Seismometry) (Atomic weapons--Testing) (Toluene)

32021
S/619/60/000/015/001/004
D039/D112

3.9300 (2406, 1019, 1109, 1327)

AUTHORS: Pasechnik, I.P., Kogan, S.D., Sultanov, D.D., Tsibul'skiy, V.I.

TITLE: Results of seismic observations during underground atomic and trinitrotoluene explosions

SOURCE: Akademiya nauk SSSR. Institut fiziki Zemli. Trudy, no. 15 (182), Moscow, 1960. Seysmicheskiy effekt podzemnykh vzryvov, 3-52

TEXT: The authors analyze seismic recordings, made chiefly in the USA and the USSR, of underground atomic explosions conducted in the USA under the names of Rainier, Tamalpays, Logan and Blanka [Abstracter's note: The English rendition of Tamalpays and Blanka could not be defined] on the test site in Nevada in 1957 and 1958, and underground trinitrotoluene explosions carried out in the Kabulsay region of the Arys' section of the Tashkentskaya zheleznaya doroga (Tashkent Railroad) on December 19, 1957, and in Pokrovsk-Ural'skiy on March 25, 1958, in order to examine the possibility of detecting and identifying underground atomic explosions. The seismic recordings of the Blanka and Logan explosions were conducted at Soviet seismographic stations

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S/619/60/000/015/001/004
D039/D112

Results of seismic observations ...

with the aid of СВК-М (SVK-M) type seismographs having a pass band of 0.2 - 2.0 seconds. Seismograms obtained by СВК (SVK), СГК (SGK) and СГК-М (SGK-M) seismographs were also used in the investigations. The SVK-M and SGK-M seismographs have been described by I.P. Pasechnik and N.Ye. Fedoseyenko (Ref. 8: "Izv. AN SSSR, seriya geofiz.", No 12, 1959.) and F.I. Monakhov, I.P. Pasechnik and N.V. Shebalin (Ref. 13: Seysmicheskiye stantsii SSSR rabotayushchiye po programme MGG [Seismic stations of the USSR working under the IGY program], Izd-vo AN SSSR, 1959.). The authors conclude that the vibrations produced by these explosions can be detected at fairly long distances from the place of explosion. Thus, nuclear explosions with a force of 19 kt were detected up to a distance of more than 16,000 km (by means of the SVK-M seismograph), and chemical explosions with a force of 3 kt - up to 9,000 km (by means of the Benioff seismograph). In the first arrivals, the P_n longitudinal waves were recorded at epicentral distances of 200 - 1100 km, the P waves at 1,200 - 10,100 km and the PKP waves - at an epicentral distance of more than 16,000 km (at the Soviet seismic stations at Mirnyy and the Banger Oasis in the Antarctic). In the case of atomic explosions, the S and S* transverse waves were identified on the recordings of the Benioff seismograph within an epicentral-distance range of 200 - 500 km. Sur-

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Results of seismic observations ...

face waves were recorded at distances of 2,000 - 3,000 km. In a chemical explosion with a force of 3 kt carried out in Pokrovsk-Ural'skiy, the S direct transverse wave was recorded at an epicentral distance of 2,300 km by means of the Benioff seismograph. In the first arrival of the longitudinal wave, the motion direction corresponding to the compression phase was recorded at epicentral distances of up to about 700 km for the Logan explosion and up to 1,000 km for the Blanka explosion by a Benioff seismograph operating in a special network of stations. The amplitude corresponding to the compression phase is of a small intensity. By correlating the initial part of the recording, it was determined that the absence of the compression phase at great epicentral distances is associated with the loss of the first extremum. Probably this loss is connected both with the rapid attenuation of high-frequency oscillations characteristic for underground explosions, as well as with the distorting effect of the equipment used. In order to distinguish explosions from earthquakes by the first arrivals, a method adopted for studying the earthquake mechanism should be used. In contrast to normal earthquakes, the distribution of the signs of the Logan and Blanka explosions does not permit drawing nodal lines. According to the Benioff seismograph recordings, the period of the P_n and P* longitudinal waves changes at epi-

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Results of seismic observations ...

central distances of 200 - 1,000 km from 0.5 to 0.8-1.0 seconds during atomic explosions, and according to the D.P. Kirnos seismograph - from 0.2 to 0.8 seconds during chemical explosions. In the case of earthquakes of approximately the same energy level, this period varies between 0.6 and 2.5 seconds (according to recordings of the D.P. Kirnos seismograph). In the case of atomic explosions, the period of S_n and S* transverse waves changes from 0.6 to 1.2 seconds at epicentral distances of 200 - 500 km (Benioff seismograph). During earthquakes of approximately the same energy level, this period changes from 1 to 4 seconds at epicentral distances of 100 - 1,000 km (D.P. Kirnos seismograph). Consequently, in underground explosions, the periods of the volumetric waves are somewhat shorter than in earthquakes of the same energy level. The Benioff seismograph recordings show that during atomic explosions the period of the surface waves at epicentral distances of 100 - 500 km is the same as that for transverse waves and amounts to 0.7 - 1.2 seconds. At epicentral distances of 500 - 2,000 km, periods of 2 - 3 seconds were recorded by seismographs with a wider pass band than the Benioff seismograph. A comparison of the surface-wave periods recorded

Results of seismic observations ...

by the D.P. Kirnos seismograph during chemical explosions and earthquakes of the same energy level showed that these periods are essentially different. During chemical explosions this period equals 2.0 $\pm$ 0.5 seconds and scarcely varies with distance. At an epicentral distance of about 1,000 km it is 4 times shorter than the surface-wave period in earthquakes. A curve representing the dependence of the surface-wave period on the distance during earthquakes is expressed according to the data of S.L. Solov'yev and N.V. Shebalin (Ref. 12: "Izv. AN SSSR, seriya geofiz.", No 7, 1957.) by the formula $T \approx 0.85\sqrt[3]{\Delta}$. This curve and a corresponding curve for the Arys' explosion are given in the paper. Observations conducted at the Frunze station agree with this dependence. It is stated that the surface-wave period may serve as one of the criteria for recognizing the recording of an explosion among earthquake recordings. The character of the change in the oscillation amplitude with an increase of the epicentral distance is different for various waves. For atomic explosions with a period T = 0.5 $\div$ 0.7 seconds the P_n wave amplitude decreases with distance according to the law

$$A_i \approx A_o \left(\frac{\Delta_i}{\Delta_o}\right)^{-2} e^{-0.0025(\Delta_i - \Delta_o)}.$$

Card 5/7

Results of seismic observations ...

For the P wave, the character of the change in the oscillation amplitude is more complicated. Within a range of 1,200 - 2,500 km the amplitude values are less than the values at large epicentral distances; considerable dispersion of these values was observed in the above-mentioned range. In the P wave, the maximum amplitude value was found at a distance of about 2,500 km after which it gradually decreased with an increase in the epicentral distance. A detailed analysis of these changes of the amplitude of the P wave was conducted by Yu. V. Riznichenko (Ref. 10: O seysmicheskikh magnitudakh podzemnykh yadernykh vzryvov [On the seismic magnitudes of underground atomic explosions], in the present source, 53-87.). During both atomic and chemical underground explosions, the character of the seismic recordings, the type of the recorded waves, the predominant oscillation periods, etc., are practically the same. Ignoring the difference in the ground conditions at the place of the explosion, the seismic effect during chemical explosions is approximately 2-4 times greater than during atomic explosions. Experimental verification of the efficiency of a control system may be conducted with the aid of explosions of common explosives. Discussing the determination of the epicenter

Card 6/7

Results of seismic observations ...

coordinates, the authors mention a method proposed by Ye.F. Savarenskiy (Ref. 11: Ye. F. Savarenskiy, D.P. Kirnos, Elementy seysmologii i seysmometrii [Elements of seismology and seismometry], Gostekhizdat, M. - L., 1949.) for locating an earthquake epicenter by the absolute moments t_1, t_2, t_3 of the arrivals of the P longitudinal wave at three seismic stations. The location of the epicenter of the Blanka and Logan explosions on the basis of the data of stations surrounding the epicenter is determined over an area of 300 km^2 by using the averaged Jeffreys-Bullen hodograph, i.e. when the regional hodograph is unknown. If the regional hodograph is used, the accuracy of location of the epicenter determination should be increased. V.I. Keylis-Borok is mentioned. There are 25 figures, 14 tables and 35 references: 13 Soviet-bloc and 22 non-Soviet-bloc. The four most recent references to English-language publications read as follows: AEC Releases Data on Hardtack Bomb Tests, Tuesday, March 10, 1959.; Disarmament and Foreign Policy Hearing Before a Subcommittee on Foreign Relations US Senate. 96 Congress 1 Session. Pt. 1. January 28, 30 and February 2, 1959, Washington, D.C. US Government Printing Office. Washington, 1959.; D.S. Carder, W.K. Cloud. Surface Motion from Large Under-ground explosions. "Journ. Geophys. Res.", 64, No 10, 1959.; K.F. Romney. Amplitudes of Seismic Body Waves from Underground Nuclear Explosions. "Journ. Geophys. Res.", 64, No 10, 1959.

Card 7/7

TSIBUL'SKIY, Ye.

Radio engineering training for the youth. Radio no.7:9-10 Jl '61. (MIRA 14:10)

1. Zaveduyushchiy sektorom TSentral'nogo komiteta Vsesoyuznogo Leninskogo kommunisticheskogo soyuza molodezhi.
(Radio)

ABRAMOV, V.S.; TSIBUNIN, V.S.

Vinylphosphinic acid esters and their polymerization capacity. (MIRA 15:5)
Trudy KKHTI no.26:96-103 '59.
(Phosphinic acid) (Polymerization)

BULGARIA

BERKUTOV, Prof A.N. [affiliation not given]; TSIBURNYAK, G.N., Candidate in the Medical Sciences (Kandidat na Meditsinskite Nauki); and NURISHTENKO, [affiliation not given].

"The Treatment of Tetanus Sufferers with Neurological Devices and Relaxing Drugs."

Sofia, Voenno Meditsinsko Delo, Vol 18, No 5, October 1963, pp 13-21.

Abstract: The authors draw on their experience with 75 cases of tetanus since 1958 to discuss ways of determining the severity of the illness (the shorter the incubation period, the more severe the case will be; the case will be severe if the period elapsing between the first clinical symptoms and the appearance of generalized cramps is less than 48 hours), the need for anti-convulsion therapy, and the development in the last decade of new and more effective drugs for this purpose which will not yield the dangerous and sometime fatal complications known to have been caused in certain cases by the earlier preparations. The authors also suggest that the application of the anti-tetanus serum should be obligatory within the framework of other therapeutic measures.

Four tables, 11 Soviet-bloc references.

1/1

ANTSIMOVA, N.L.; TSI-CHZHEN', Ye.

Simplified method for constructing the boundaries of asynchronous zone III self-excitation taking into account the frequency characteristics of a synchronous machine. Trudy MEI no.54:93-102 '64.

Appearance of a boundary between synchronous and asynchronous self-excitation in zone $x_d < x_e < x_q$. Ibid.:309-316 (MIRA 17:12)

TSICURA, C.; RADULESCU, A.

New masonry materials for building dwellings. p.297.

REVISTA CONSTRUCTIILOR SI A MATERIALELOR DE CONSTRUCTII. (Asociatia Stiintifica a Inginerilor si Tehnicienilor din Rominia si Ministerul Constructiilor si al Materialelor de Constructii)
Bucuresti, Rumania
Vol. 11, no. 6, June 1959.

Monthly list of Eastern European Accession Index (EEAI) LC vol. 8, no. 11
November 1959
Uncl.

TSIDAYEV, S.

In 1956 we will build even faster. Sel'.stroi.11 no.2:3-4 F '56.
(MLRA 9:7)

1. Nachal'nik Upravleniya po stroitel'stvu v kolkhozakh Severo-Osetinskoy ASSR.
(Ossetia--Farm buildings)

TSIDAYEV, S.

On collective farms in Northern Ossetia. Sel'. stroi. 12 no.2:3-4 F '58. (MIRA 11:2)

1. Nachal'nik upravleniya po stroitel'stvu v kolkhozakh pri Sovete Ministrov Severo-Osetinskoy ASSR.
(Ossetia--Farm buildings)

1. TSIDAYEV, S.

2. USSR (600)

4. Farm Buildings

7. Let's construct capital livestock buildings. Sel'.stroi. 7 no. 6, 1952.

9. Monthly Lists of Russian Accessions, Library of Congress, March 1953, Unclassified.

TSIDILIN, M.

Dolls on the assembly line. Prom.kcop. no.7:24-25 Jl '57.
(MLRA 10:8)

1.Predsedatel' pravleniya arteli imeni Krasnoy Armii, g. Zagorsk, Moskovskoy oblasti.
(Dolls)

B. T. R.
Vol. 3 No. 4
Apr. 1954
Electronics

4888 Rectification by Semiconductors in a Thermal Field. I. M. Tsidil'kovsky. *National Science Foundation Translation*, no. 85, Sept. 1953, 5 p. (Original in *Doklady Akademii Nauk SSSR*, v. 91, no. 1, July 1953, p. 63-66.)
Results show that rectification coefficient increase is greater when dissociation energy is larger and additive concentration and hole mobility is smaller. Graphs. 6 ref.

TSIDILKOVSKIY, I. M.

"Appearance of Asymmetry of Electric Conductivity in Semiconductors With Stopping Layers Under Action of Temperature Gradient".
Izv. AN Az SSR, No 11, pp 3-20, 1954

The effect of the temperature gradient on the electric conductivity of a semiconductor with chemical stopping layers at its electrodes (thermal rectification of semiconductors with boundary resistances) is theoretically analyzed. The hole semiconductor (type Cu_2O) with equal stopping layers at its electrodes is studied. At $\nabla T = 0$ the semiconductor does not rectify; however, at $\nabla T = 0$ an asymmetry of electric conductivity arises and the semiconductor starts rectifying. Poisson's equation and equations of diffusion and current are solved. (RZhFiz, No 10, 1955)

SO Sum No 812, 6 Feb 1956

Tsidil'kovskiy, I. M.

USSR/Physics - Semiconductor parameters FD 1076

Card 1/1 Pub. 153 - 12/24

Author : Bass, F. G., and Tsidil'kovskiy, I. M.

Title : A method for determining the parameters of a semiconductor

Periodical : Zhur. tekh. fiz., 24, No 10, 1834-1836, Oct 1954

Abstract : The authors investigate the possibility of determining the mobility of current carriers and the value n defined by the formula $L\,L_0(T)v^n$ (where L is the length of the free path of the current carriers, v is their speed, and T is the temperature) on the basis of investigations of certain galvanic and thermomagnetic phenomena. They find that the most convenient parameters are the Hall effect and the Nernst-Ettingshausen longitudinal and transverse effects and also two new so-called longitudinal-transverse effects, which are described for the first time in this work. One of the authors had predicted these theoretically and discovered experimentally.

Institution : -

Submitted : May 6, 1954

USSR/Physics - Thermomagnetic Effect

FD-2842

Card 1/1 Pub. 153-25/30

Author : Daibov, A. Z. and Tsidilkovskiy, I. M.

Title : Thermomagnetic Effect of Nernst-Ettinghausen in Tellurium

Periodical : Zhur. Tekh.Fiz, 25, 742-746, 1955

Abstract : The Nernst-Ettinghausen effect in tellurium was experimentally investigated in a temperature range of 123°K to 483°K for clarification of peculiarities. Formulas are derived and analyzed. Thanks for discussions are expressed to Kh. I. Amirkhanov anf V. P. Zhuze. Four references, 2 US.

Institution :

Submitted : September 8, 1954

ACCESSION NR: AP4041045 S/0120/64/000/003/0172/0174

AUTHOR: Davy*dov, A. B.; Tsidil'kovskiy, I. M.

TITLE: Investigating the resistivity in a magnetic field at superhigh frequencies

SOURCE: Pribory* i tekhnika eksperimenta, no. 3, 1964, 172-174

TOPIC TAGS: semiconductor, semiconductor resistivity, semiconductor resistivity in magnetic field, SHF semiconductor testing

ABSTRACT: A T-bridge (see Enclosure 1) with well-decoupled arms is suggested for measuring the resistivity of semiconductors (within 1—1,000 ohm-cm and $\Delta\rho/\rho_0 = 10^{-5}$) in a magnetic field. The klystron oscillator 3 feeds power, at 9,375 mc, via ferrite gate 5 to the H-arm; one-half the power goes into arm 2 with attenuator 6 and shorting plunger 7; the other half goes into arm 1 containing specimen 8 and plunger 9. The E-arm of the bridge, containing a ferrite gate and receiver 10, receives the power determined by the bridge tuning and side-arm

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ACCESSION NR: AP4041045

parameters. An SCh-2 frequency-spectrum analyzer with a sensitivity of 5×10^{-11} w was used as a receiver. The transverse resistivity of n-Ge specimens with 10 and 40 ohm-cm was measured at 300K, with various orientations of the magnetic field with respect to the crystallographic axes. The results for the 10-ohm-cm specimen corroborated G. L. Pearson's, et al., earlier measurements (Phys. Rev., 1951, 93, 763). Orig. art. has: 5 figures and 9 formulas.

ASSOCIATION: Institut fiziki metallov (Institute of Physics of Metals)

SUBMITTED: 25May63 ENCL: 01

SUB CODE: EC NO REF SOV: 003 OTHER: 003

Card 2/2

S/0126/64/017/001/0155/0158

ACCESSION NR: AP4013106

AUTHORS: Pomortsev, R. V.; Tsidil'kovskiy, I. M.

TITLE: Motion of conduction electrons in a strong electric field

SOURCE: Fizika metallov i metalloved., v. 17, no. 1, 1964, 155-158

TOPIC TAGS: conduction electron, cubic lattice, strong bond approximation, conductivity

ABSTRACT: Electron motion in the periodic field of a crystal with applied electric and magnetic fields is considered. The periodic field of the crystal causes vibration of the electron with its motion limited to one band with a frequency

$$\omega_0 = \frac{eEa}{h}$$

and amplitude

$$r_0 = \frac{2\Delta\varepsilon}{eE},$$

Card 1/3

where E is the electric field intensity, a is the lattice constant, and $\Delta\varepsilon$ is the width of the band. Electron-lattice collisions are not considered; i.e., $r_0 \ll 1$ — the mean free path of the electron. Assuming a simple cubic lattice in the strong bond approximation and taking the applied electric E and magnetic H fields to be parallel to the x and z axes respectively, the equations of motion for the electron are written which can not be solved directly. The simplified equation does not have a solution if

$$\frac{cE}{H} < 2\frac{\Delta\varepsilon\, a}{h}.$$

Otherwise, it is found that the electron velocity in the x direction is given approximately by

$$v_x \approx \Delta\varepsilon \frac{a}{h} \sin \omega t,$$

where $\omega = \frac{\pi}{2K}\omega$ and $K = \int_0^{\pi/2} \frac{dx}{\sqrt{1 - \left(2\Delta\varepsilon \frac{a}{h} \cdot \frac{H}{cE}\right)^2 \sin^2 x}}$.

ACCESSION NR: AP4013106

It is shown that the effect of the magnetic field is to decrease the vibration frequency of the electron and to increase the amplitude. Taking the time average of v_x including the probability of electron-lattice collision indicates that the conductivity,

$$\sigma \sim E^{-2} .$$

It is concluded that the possibility of observing these effects is increased with better fulfillment of the two conditions mentioned above. This is satisfied in semiconductors with sufficiently narrow energy bands. Orig. art. has: 45 equations.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Physics of Metals AN SSSR)

SUBMITTED: 27May63 DATE ACQ: 26Feb64 ENCL: 00

SUB CODE: SS NO REF SOV: 003 OTHER: 000

Card 3/3

ACCESSION NR: AP4013532 S/0181/64/006/002/0627/0631

AUTHOR: Tsidil'kovskiy, I. M.

TITLE: Once again on scattering of current carriers in compounds of the type InSb (an answer to a letter to the editor by V. V. Galavanov, FTT, 5, 625, 1963)

SOURCE: Fizika tverdogo tela, v. 6, no. 2, 1964, 627-631

TOPIC TAGS: electron scattering, hole scattering, concentration band, Fermi level, optical vibration

ABSTRACT: The author asserts that the first criticism of V. V. Galavanov that, in a parabolic conduction band, the mobility of electrons should decrease instead of increase with increase in Fermi level is valid, but follows from an error in the original text, whether typographical or otherwise. The original text, he states, should have read "decrease" instead of "increase." He points out another error in the original text: that the power at the parenthesis in eq. (13) should be $-\frac{1}{2}$, not $\frac{1}{2}$. As for Galavanov's criticism of his neglect of effective electron mass, he points out that his evaluations were for energy bands differing from those at which this consideration applies, and he shows that at some energy values the probability of electron scattering at ion impurities (and at optical vibrations) increases with concentration, but that at others (those he considered)

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ACCESSION NR: AP4013532

the probability decreases. The other points brought up by Galavanov he considers trivial. He reconsiders the scattering of holes and concludes that Galavanov is in error in maintaining that optical vibrations are a leading factor in the scattering of holes in compounds of the InSb type. "In conclusion, I consider it my duty to thank the author of the letter in FTT, 5, 625, 1963, V. V. Galavanov, for stimulating further analysis of the problem relative to scattering of current carriers in compounds of the InSb type."

ASSOCIATION: Institut fiziki metallov AN SSSR, Sverdlovsk (Institute for the Physics of Metals AN SSSR)

SUBMITTED: 18Sep63 DATE ACQ: 03Mar64 ENCL: 00

SUB CODE: EC,SS NO REF SOV: 005 OTHER: 004

Card 2/2

USSR/Physics - Semiconductors TSIDIL'KOVSKIY, I.M.

Card 1/1 Pub 146-18/25

Author : Tsidil'kovskiy, I. M., and Bass, F. G.

Title : G. M. Avak'yants' work "Theory of the equations of transfer in strong electric fields"

Periodical : Zhur. eksp. i teor. fiz. 28, 245, February 1955

Abstract : The necessity for a theoretical investigation of the properties of superconductors in strong electric fields prompted G. M. Avak'yants (ibid. 25, 562, 668, 1954) to study transfer phenomena in semiconductors in which the electron gas is strongly heated. The authors remark that Avak'yants' work does not interpret experimental results (e.g. Poole's effect) and does not present anything new in the problem of the behavior of semiconductors in strong electrical fields; and that Avak'yants in his calculation of j_0 neglected the term taking account of the transition of electrons in the conductivity zone (or into local levels). Three references; e.g. B. I. Davydov, ibid. 6, 471, 1936 (here Davydov obtained the dependence of electric conductivity upon electric field strength in a form true for only for superconductors).

Institution: Dagestan Affiliate, Academy of Sciences USSR, Makhachkala

Submitted : July 12, 1954

USSR/Physics - Semiconductors TSIDIL'KOVSKIY, I.M. FD-1847

Card 1/1 Pub. 146-7/25

Author : Bass, F. G., and Tsidil'kovskiy, I. M.

Title : Theory of the effects of Hall and Nernst-Ettingshausen in semiconductors with mixed conductivity

Periodical : Zhur. eksp. i teor. fiz. 28, 312-320, March 1955

Abstract : The authors calculate the Hall and Nernst-Ettingshausen emf, and also the distribution of the concentrations of the current carriers in a semiconductor with mixed conductivity located in an inhomogeneous magnetic field. They take into consideration the presence of levels which are due to admixtures, and the recombination of current carriers. The authors thank Kh. I. Amirkhanov and V. P. Zhuze. Five references, 3 USSR: A. I. Gubanov, ibid., 21, 97, 1951; A. I. Ansel'm, Zhur. tekh. fiziki, 22, 1146, 1952; K. B. Tolpygo, Trudy In-ta fiziki AN USSR, 3, 52, 1952.

Institution: Dagestan Affiliate, Academy of Sciences USSR, Makhachkala

Submitted : March 4, 1954

TSIDIL'KOVSKIY, I.M.

USSR/ Physics - Semi-conductors

Card 1/1 Pub. 22 - 22/53

Authors : Tsidul'kovskiy, I. M.

Title : Regarding the ion and homeopolar bond of semi-conductors

Periodical : Dok. AN SSSR 102/4, 737-740, Jun 1, 1955

Abstract : Experiments with semi-conductors (Cu_2O, ZnO, PbS, PbSe) are described. The experiments were conducted to determine the causes of the discrepancies between the theory and experimental data. The experiments were conducted in the view of the Hall and Ettingshausen effects. It led to the assumption that semi-conductors might not be ionic crystals, as the theory considered them, but crystals of a plain chemical bond, i.e., homeopolar type crystals. Twenty-three references: 1 Brit., 5 French, 7 USA, and 10 USSR (1029-1954). Graphs.

Institution : Academy of Sc., USSR, the Dagestan Branch

Presented by: Academician A. F. Ioffe, February 16, 1955

TSIDIL'KOVSKIY, I. M.

Tsikil'kovskiy, I. M.

"The Nernst-Ettingshausen thermomagnetic effect in semiconductors." Leningrad Order of Lenin State U imeni A. A. Zhdanov. Leningrad, 1956 (Dissertation for the degree of Candidate in Physicomathematical Science)

Knizhnaya letopis'
No. 25, 1956. Moscow

BASS, F.G.; BASHIROV, R.I.; TSIDIL'KOVSKIY, I.M.

Theory of isothermic galvanomagentic and thermomagnetic phenomens in semiconductors. Izv.AN Azerb.SSR no.10:3-16 O '56.
(MLRA 10:3)

(Semiconductors)

AMIRKHANOV, Kh.I.; BASHIROV, R.I.; DAIBOV, A.Z.; TSIDIL'KOVSKIY, I.M.

Thermonagnetic phenomena in semiconductors. Izv.AN SSSR.Ser.fiz. 20 no.12:1519-1520 D '56. (MLRA 10:3)
(Semiconductors) (Thermomagnetism)

TSIDIL'KOVSKIY, I.M.

SUBJECT USSR / PHYSICS CARD 1 / 2 PA - 1558
AUTHOR BASIROV,R.I., CIDIL'KOVSKIJ,I.M.
TITLE The NERNST-ETTINGSHAUSEN-Effect in Germanium.
PERIODICAL Žurn.techn.fis, 26, fasc.10, 2195-2199 (1956)
Issued: 11 / 1956

The study of this NERNST-ETTINGSHAUSEN-effect (N.E.-effect) makes it possible to determine the temperature dependence of the mobility of the current carriers within the domain of actual conductivity as well as to solve the problem as to what scattering mechanism dominates at low temperatures. At first a formula for the dimensionless N.-E. field for the case of an atomic semiconductor is written down for the case of actual conductivity (where the concentrations N_- of the electrons and N_+ of the holes are equal to one another). This formula is then specialized for germanium (on the condition that $u_+ \sim T^{-\alpha}$), and at $1 \leqslant b \leqslant 4$ ($b = u_-/u_+$) the equation $|\mathcal{E}_y| \sim T^{-\alpha-1}$ is found for the temperature dependence of the N.E.field. Only at high temperatures it is approximately true that $|\mathcal{E}_y| \sim T^{-\alpha}$. Next, a formula for the NERNST-ETTINGSHAUSEN-field at low temperatures is given. The N.E.-effect makes it possible to distinguish clearly between the different scattering mechanisms of current carriers.
The present work deals with measuring the N.E.effect in various pure samples of n- and p-germanium in the temperature interval of 125-650° K at a magnetic field strength of H = 7400 Ørstedt. Measuring results are shown in a diagram. In a

Žurn.techn.fis,26,fasc.10, 2195-2199 (1956) CARD 2 / 2 PA - 1558

monocrystal of the p-type with a specific resistance of 0,18 ohm.cm the curve of the temperature dependence of $\mathcal{E}_y(T)$ consists of two parts: At $T < 390^\circ$ K, $\mathcal{E}_y > 0$ and at $T > 390^\circ$ K $\mathcal{E}_y < 0$ is true. In n-monocrystals with 0,01; 3,0 and 11 ohm.cm (all specific resistances are for 295° K) as well as in a p-monocrystal with 48,5 ohm.cm the N.E. field is negative within the entire investigated temperature range. In all samples a maximum of $\mathcal{E}_y(T)$ is found at high temperatures, where $\mathcal{E}_y < 0$ is true, which is connected with the transition from the admixture domain into the domain of actual conductivity. With the quantity of admixtures in the sample also the equilibrium temperature of holes and electrons rises, and with an increase of the mobility of the current carriers also the maximum will rise. At low temperatures the temperature dependence of the N.E.-effect is rather complicated. At the lowest temperatures N.E. field strength (as also mobility) grows with increasing temperature. At higher temperatures dispersion at the oscillations of the lattice gains in importance and the N.E. field changes its sign. Within a certain average range of temperature $\mathcal{E}_y$ can attain a maximum. In conclusion further properties and particularly the domain of actual conductivity are discussed.

INSTITUTION: Dagestan Branch of the Academy of Science in the USSR, MACHACKALA!

[illegible]

SUBJECT USSR / PHYSICS CARD 1 / 2 PA - 1892
AUTHOR BASS,F.G., CIDIL'KOVSKIJ,I.M.
TITLE The Theory of Isothermal Galvano- and Thermomagnetic Phenomena in Semiconductors.
PERIODICAL Žurn.eksp.i teor.fis,31,fasc.4,672-683 (1956)
Issued: 1 / 1957

The present work investigates the generalization of the theory to the domain of medium and strong effective magnetic fields for different types of interaction between current carriers and a crystal lattice. Furthermore, it is explained what peculiarities of galvano- and thermomagnetic phenomena depend on statistics and on the law of dispersion. Only isothermal effects are dealt with here because the adiabatic effects differ but little with respect to order of magnitude from isothermal effects.

Semiconductors with current carriers of one type: At first the equations of transition are written down and expressions for the densities of the electric and the thermal currents are written down. The integrals occurring therein are expressed in potential series and this decomposition is in general of an asymptotic character. The errors of the formulae derived here amount to less than 4%. Galvanometric phenomena: At first two equations for the determination of E_y and E_z are given. In the general case with any statistics, any dispersion law, and any dependence of relaxation time on quasimomentum, the (HALL'S) field E_y changes its sign together with the magnetic field. If the magnetic field has the same direction as the primary electric field, HALL'S field becomes equal to

Žurn.eksp.i teor.fis,31,fasc.4,672-683 (1956) CARD 2 / 2 PA - 1892

zero. Thermomagnetic phenomena: The field E'_y which is due to the transversal NERNST-ETTINGSHAUSEN effect, changes its sign together with the magnetic field. The limiting cases of strong and weak effective magnetic fields are investigated. In the case of weak magnetic fields φ, E'_x depends quadratically on the "effectivity" of the magnetic field and in the case of strong field strengths it tends towards saturation. E'_y increases linearly in weak fields with growing φ, and decreases in strong fields like $1/\varphi$.

Semiconductors with mixed conductivity: Already some percents of unreal current carriers can exercise considerable influence on the character of thermomagnetic effects. In the case of weak effective field strengths HALL'S field depends linearly on $\varphi_{\pm}$, but it can change its sign according to the ratio of concentrations and mobilities of holes and electrons. The relative change of electric conductivity is proportional to $\varphi^2_{\pm}$. The formulae for E'_x and E'_y are derived. Also here the limiting cases of strong and weak effective fields are investigated. At $\varphi_{\pm} \ll 1$ the longitudinal and the transversal NERNST-ETTINGSHAUSEN field depend on the effective field just as much as in the case of semiconductors with current carriers of one sign.

INSTITUTION:

TSIDIL'KOVSKIY, I.M.

SUBJECT USSR / PHYSICS CARD 1 / 2 PA - 1991
AUTHOR CIDIL'KOVSKIJ,I.M.
TITLE The NERNST-ETTINGSHAUSEN Effect in Strong Magnetic Fields.
PERIODICAL Žurn.techn.fis, 27,fasc.1, 12-22 (1957)
Issued: 2 / 1957

For the purpose of verifying the corresponding theory the author carried out an experimental investigation of the transversal NERNST-ETTINGSHAUSEN effect for the case that $uH/c \gtrsim 1$ is true. Together with the transversal N.E.effect also the longitudinal N.E. effect and the longitudinal-transversal thermomagnetic effect which had been predicted theoretically by F.G.BASS and I.M.CIDIL'KOVSKIJ (Žurn.techn.fis. 24, 834 (1954)) were investigated. A compound of the type II-VI-HgSe served as test object. The mercury selenide satisfies the rule by GRIMM-SOMMERFELD, i.e. it has a structure of the type of zinc mica, and its binding is homoeopolar.
The production of the mercury-selenide samples is described in short. Measurements were carried out within the temperature interval of from 130 - 480° K. The angle between the planes of equal temperature and the magnetic field amounted to 45°.
Experimental results and conclusions: The dependence of the transversal NERNST-ETTINGSHAUSEN effect on temperature and on magnetic field strength can be explained in the case of mercury selenide (which has a conductivity of a sign) on the basis of the theory for medium and strong magnetic fields. A simple way is found for the motion of the current carriers from the maximum

Zurn.techn.fis,27,fasc.1, 12-22 (1957) CARD 2 / 2 PA - 1991

of the function $\mathcal{E}_y(H)$ and, on certain conditions, also from $\mathcal{E}_y(T)$. Here $\mathcal{E}_y$ denotes the dimensionless NERNST-ETTINGSHAUSEN field. The mobilities computed in this manner and their temperature dependence thus agreee well with the corresponding values computed from the HALL effect. Within the domain of fields of medium strength the value of mobility determined from the NERNST-ETTINGSHAUSEN effect is more reliable than the value determined from the HALL effect. Also the abnormally small shiftings of the maxima of $\mathcal{E}_y(T)$ towards lower temperatures in the case of a reduction of magnetic field strength were explained. The sign of the NERNST-ETTINGSHAUSEN effect indicates that the free length of path of the electrons does not depend on velocity. According to theory this corresponds to the case of homoeopolar binding.

The longitudinal-transversal thermomagnetic effect prodicted by theory was here investigated experimentally for the first time. Also the longitudinal NERNST-ETTINGSHAUSEN effect was studied on this occasion. Agreement with theory and with the data of the transversal NERNST-ETTINGSHAUSEN effect is satisfactory in both cases.

INSTITUTION: Daghestanic Branch of the Academy of Science in the USSR, MACHACKALA.

AUTHOR Tsidil'kovskiy, I.M. 57-8-14/36

TITLE Nernst-Ettingshausen Effect in Mercuric Telluride. (Effekt Nernsta-Ettingsgauzena v telluride rtuti.)

PERIODICAL Zhurnal Tekhn. Fiz., 1957, Vol. 27, Nr 8, pp. 1744-1752 (USSR)

ABSTRACT The results of investigation of the Nernst-Ettingshausen effect (N.-E.) in the compound of the $A_{II}B_{VI}$-type-mercuric telluride-are given. The investigations of the N.-E.- as well as of the hall-effect and the electric conductivity showed that in dependence on the purity and on the polycrystal degree mercuric telluride above 200-230° Kelvin is a semi-conductor with great movability of electrons. The maximal movability of electrons of the samples investigated reaches 1,15·10⁴ qcm/Vsec. at room temperature. This way conditions were realized for the first time which make possible a checking of the theory of the N-E. effect for the case of the concentration equality of electrons and holes under conditions which were close to strong effective magnetic fields. In qualitative respect the experiment coincided with the theory. By means of the theory of thermo-magnetic phenomena all characteristics of reaction in the case of the N.-E.- effect are explained here. According to the data of the N.-E.-effect the maghitude and the dependence on the temperature of the

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57-8-14/36

Nernst-Ettingshausen Effect in Mercuric Telluride.

ratio of electronic- and hole movability was classified as $b = \frac{u_-}{u_+}$. At 300° Kelvin b = 9,7. The movability of electrons, classified according to the hall effect, under 200° Kelvin is approximately expressed by the law $u_- \sim T^{\frac{3}{2}}$, and from 200° - 500° Kelvin by $u_- \sim T^{-\frac{1}{2}}$.

(With 6 illustrations and 6 Slavic references)

ASSOCIATION: Dagestan Branch of the Academy of Sciences of the USSR (Dagestanskiy filial AN SSSR.)
SUBMITTED: December 29, 1956
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CARD 2/2

20-117-5-14/54

AUTHORS: Amirkhanov, Kh.I., Member of the Academy of Sciences of the Azerbaydzhan SSR, Bashirov, R.I., Daibov, A. Z., Tsidil'kovskiy, I. M.

TITLE: The Influence of the Phonon Drag Effect on Thermomagnetic Phenomena in Bismuth Selenide (O vliyanii effekta "uvlecheniya" na termomagnitnyye yavleniya v selenide vismuta).

PERIODICAL: Doklady AN SSSR, 1957, Vol. 117, Nr 5, pp. 781 - 784 (USSR)

ABSTRACT: The authors here investigate the electric conductivity, the Hall-effect, the thermoelectromotoric force and the transversal and longitudinal Nernst-Ettinghausen-(Ettingsgauzen)- effect of ten polycrystalline samples of bismuth-selenide. These samples were produced by a compression at high temperature or by a slow cooling of the smelting. The methods of measurements were already described in two previous papers by the author (reference 3,4). The measurements described here were conducted in the temperature interval from 120 - 700°K. Here the results of the examination of six samples are given. The properties of the different samples are shortly enumerated. In the case of crystals with a predominantly homoeopolar bonding (comprising bismuth-selenide) the Nernst-Ettinghausen (Ettingsgauzen) effect must be positive. The Nernst-Ettinghausen effect is caused in one of the samples of Bi_2Se_3 in the range of low temperatures investigated here mainly by the

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drag of electrons by phonons. This presumption is verified by measuring the thermoelectromotive force. The experiments of the authors showed, that with concentrations of $N \sim 10^{18}$ cm^{-3} of the current carriers the drag has a decisive influence on the Nernst-Ettinghausen (Ettinggauzen) effect and on the thermoelectromotive force. The longitudinal Nernst-Ettinghausen (Ettinggauzen) effect was also investigated in Bi_2Se_3, it turned out to be relatively weak, however. The discrepancies between the values of mobility determined from the Hall effect and from the Nernst-Ettinghausen (Ettinggauzen) effect, (which were observed in PbS, PbSe, and PbTe at low temperatures), are obviously caused by the influence of drag on the Nernst-Ettinghausen (Ettinggauzen) effect. There are 4 figures and 15 references, 7 of which are Slavic.

ASSOCIATION: Dagestan Branch AS USSR, Makhachkala (Dagestanskiy filial Akademii nauk SSSR, Makhachkala).

SUBMITTED: June 11, 1957

Card 2/2

AUTHORS: Zhuze, V. P., Tsidil'kovskiy, I. M., Bartnitskaya, T. S. SOV/57-58-8-4/37

TITLE: Thermomagnetic Phenomena in Silver Telluride (Termomagnitnyye yavleniya v telluride serebra)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Nr 8, pp. 1646 - 1650 (USSR)

ABSTRACT: This is a study of the Nernst-Ettinghausen-effect, of the thermo e.m.f., of the electric conductivity and of the Hall-(Kholl) effect in Ag_2Te and AgTe in the temperature interval of 120-600°K. The measuring methods are described in reference 5. The nature of the variations of the temperature dependence of σ and R agrees with observations made by Appel(Ref 8). Diagrams showing the temperature dependence of the dimensionless fields of the transverse and of the longitudinal Nernst-Ettinghausen effect φ_y and φ_x, respectively, and the temperature coefficient α of the thermo e.m.f. are given. The negative sign and the great absolute value of φ_y at temperatures below 200°K can be explained by the effect of phonon

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drag $\ell_x > 0$. This indicates a considerable effect exerted by the phonon drag upon the longitudinal Nernst-Ettinghausen effect at low temperatures. In the range of 200-420°K $\ell_y > 0$. ℓ_y varies about as $T^{-2,5}$ and hence also $u \sim T^{-2,5}$. It is assumed that $n = 0$ that is to say that a carrier scattering on acoustic low-frequency oscillations corresponding to a covalent type of binding is prevalent. The relation $u \sim T^{-2,5}$ can be explained by a multiple phonon scattering of the carriers. Around 420°K the ℓ_y field decreases markedly and changes its sign. At a further temperature rise of up to $T \simeq 490$°K it first increases again, decreasing subsequently and passing through a minimum at $T \approx 550$°K. The jump-like variation of ℓ_y occurs at a temperature near the phase transition temperature. The inversion of the sign in the longitudinal Nernst-Ettinghausen effect in the point of phase transition undoubtedly indicates a change in the type of binding. The negative sign of ℓ_y above 420°K indicates that α-Ag_2Te is a semiconductor with a prevailing ion binding

the Debye temperature of which is less than 420°K. The theory of Howarth-Sondheimer (Ref 15) was not convincingly substantiated by experiments. According to the opinion of the authors it is unsuited for the computation of the parameters of semiconductors. The section of the thermo e.m.f. versus temperature curve shows a peculiar course in the range of high temperature. α is positive at $T \simeq 395°K$, reaches a maximum at 490°K (320μV/degree). At a further rise of temperature it decreases a little. This behaviour of $\alpha(T)$ can be explained by the assumption of a superposition of the electron thermo e.m.f. by a relatively great thermo e.m.f. caused by the mobile silver ions(Ludwig-Soret-effect) at high temperatures. The experimental results obtained from AgTe are given in short. The electric conductivity and the Hall-(Kholl) constant of AgTe vary continuously, whereas R decreases with a rise of temperature above 250°K and σ increases in the same temperature range. Contrary to evidence obtained by Appel R inverses it sign. The modification of the sign in the Hall-effect at a temperature rise suggests a transition into the range of mixed conductivity. The repeated inversion of the sign (from minus to plus) at 455°K is apparently determined by the Ludwig-

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Soret-effect as in Ag_2Te. It is shown that in AgTe ℓ_y varies continuously in the whole temperature range, remaining negative everywhere. Below 200°K the functions $\ell_y(T)$ and $\alpha(T)$ substantiate an influence of the phonon drag upon both effects. The law governing the decrease of α, reads as in Ag_2Te: $\alpha \sim T^{-3}$. The results confirm the existence of a prevailing ion binding. There are 2 figures and 17 references, 9 of which are Soviet.

SUBMITTED: December 12, 1957

Card 4/4

AUTHOR: Tsidil'kovskiy, I. M. SOV/ 57-28-7-2/35

TITLE: Adiabatic Galvano-and Thermomagnetic Phenomena in Semiconductors (Adiabaticheskiye gal'vano- i termomagnitnyye yavleniya v poluprovodnikakh) I. Impure Semiconductors (I.Primesnyye poluprovodniki)

PERIODICAL: Zhurnal tekhnicheskoy fiziki, 1958, Vol 28, Nr 7, pp. 1371 - 1381 (USSR)

ABSTRACT: Adiabatic galvano-and thermomagnetic phenomena in not degenerated semiconductors are investigated for the case of strong magnetic fields. The kinetic equation for current carriers is solved under the assumption of a relaxation time according to a known scheme (e.g.Ref 7). If the angle θ between the primary electric (or thermal) field and the strength H of the magnetic field is arbitrary, the formula for the electricity flow j and the thermal flow W_e (which is transferred by the current carriers) can be reproduced in form of the formulae (1) and (2). The calculation is carried out with the assumption of a quadratic dependence of the energy on the quasi-impulse, of an arbitrary exponential dependence of the relaxation time on the quasi-impulse

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and of a Maxwell equilibrium distribution function, -equations (3). In the case of strong magnetic fields, i.e.where $(\frac{uH}{c})^2 \gg 1$ (u-the mobility of the current carriers, c-the velocity of light), the integrals $J_i j$ of the equations (2) and (1) can be decomposed into a series with respect to $(\frac{uH}{c})^2$. In the case of calculations the desintegration is stopped with one of the final terms of the series-usually not higher than the second order of infinitesimals (Refs 1-7) which corresponds absolutely to the rules. In the investigation of the galvanomagnetic phenomena the direction of the primary current is assumed to coincide with the x-axis, and the magnetic field strength to lie in the xz-plane. In the investigation of the Ettingshausen effect it is shown that in strong magnetic fields in the region of the intermediate fields where

$\frac{uH}{c} \gtrsim 1$, P' must have a maximum. The maximum $P'(\frac{uH}{c})$ does not lie $\frac{uH}{c} = 1$, but is shifted in dependence on the ratio

λ_e / λ_{Ph}. λ_e-electronic thermal conductivity, λ_{Ph}-phonon thermal conductivity. In the investigation of the Hall effect the formula (8) is derived for the Hall constant and by the comparison of the latter with the formula (21) (Ref 5) it is shown that in strong magnetic fields the difference $R_{adiabatic} - R_{isothermal}$ is proportional to $\frac{\lambda_e}{\lambda_{Ph}} H^2$, i.e. that this difference is independent of the ratio of the electron-and phonon-part of the thermal conductivity. In the investigation of the galvanomagnetic longitudinal-transverse effect and of the electric conductivity in the magnetic field the equation (12) is derived for the alteration of the electric conductivity. This equation shows that the alteration of the electric conductivity in a weakly magnetic field can differ considerably from the corresponding alteration of σ under isothermal conditions in the case of sufficiently great electronic thermal conductivity. The Ettingshausen effect is computed in the case of the absence of an electric transverse field, i.e. $E_y = 0$, and the equation (15) obtained for the case of strong magnetic fields. It is shown that if $E_y = 0$ the Ettings-

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hausen effect has to have signs inverse to the effect at $j_y=0$ in the case of semiconductors with covalent binding (n=0), and will, according to the absolute amount at $\Theta = \frac{\pi}{2}$ amount to the fivefold of the last. The Nernst effect is determined according to the formula (17) (in strong magnetic fields). The connection between the Nernst effect, the thermal conductivity, and the longitudinal effect of Nernst-Ettingshausen is shown: formula (19a). In the investigation of the thermomagnetic phenomena the Leduc-Righi effect, the transversal effect, and the longitudinal effect of Nernst-Ettingshausen, the effect of Madzhi-Righi-Leduc (effect of the thermal conductivity alteration in the magnetic field) are discussed. In the case of the Leduc-Righi effect the position of the maximum and the dependence on λ_e/λ_{Ph} is equal to that of the Ettingshausen effect. The comparison of the formula (24) for the transversal effect of Nernst-Ettingshausen with the formula (8) shows that in strong fields, if the conditions of the experiment are not isothermal, this circumstance has different consequences on the effect of Nernst-Ettingshausen and its galvanomagnetic analogue - the Hall effect. The longitudinal effect

Adiabatic Galvano-and Thermomagnetic Phenomena in Semiconductors. I. Impure Semiconductors 30V/57-23-7-2/35

of Nernst-Ettingshausen is in the case of strong magnetic fields the only one of all galvano-and thermomagnetic effects to permit an immediate determination of the exponent n in dependence of the free path length of the current carrier on the velocity. In the investigation of the effect of Madzhi-Righi-Leduc the formula (32) is derived for the case of strong magnetic fields. Finally rules governing the galvano-and thermomagnetic phenomena as well are shown. Kh. I. Amirkhanov discussed the paper with the author. There are 10 references, 7 of which are Soviet.

ASSOCIATION: Dagestanskiy filial AN SSSR, Makhachkala (Dagestan Branch, AS USSR, Makhachkala)

SUBMITTED: July 17, 1957

1. Semiconductors--Physical factors

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ZHUZE, V.P.; TSIDIL'KOVSKIY, I.M.

Thermomagnetic effects in InSb. Zhur. tekh. fiz. 28 no.11:2372-2381 N '58. (MIRA 12:1)
(Indium antimonide) (Thermomagnetism)

TSIDIL'KOVSKIY, I. M. Doc Phys-Math Sci -- (diss) "Thermomagnetic phenomena in semiconductors." Sverdlovsk, 1959. 23 pp (Acad Sci USSR. Phys Tech Inst), 150 copies (KL, 49-59, 137)

SOV/126-7-6-1/24

AUTHORS: Vzdornov, V. Ye. and Tsidil'kovskiy, I. M.

TITLE: The Effect of Current-Carrier Degeneracy on Transport Processes in Semiconductors

PERIODICAL: Fizika metallov i metallovedeniye, 1959, Vol 7, Nr 6, pp 801-808 (USSR)

ABSTRACT: In semiconductors with high conductivity, conditions are sometimes encountered when the current-carrier distribution is not of the Maxwell-Boltzmann type, i.e. the electron gas becomes partially degenerate. Physical properties of degenerate semiconductors were first discussed by Samoylovich and Korenblit (Ref 1). Some formulae and graphs dealing with the transport processes in degenerate semiconductors placed in weak magnetic fields are given in a paper by Wright (Ref 2). Unfortunately, Wright's paper contains a number of errors. Deduction of the formulae for the adiabatic (Ettingshausen and Righi-Leduc) coefficients did not allow for the thermal conductivity of the lattice which, in semiconductors, is considerably greater than the electronic thermal conductivity. Wright's formula, which gives the variation of resistance in a magnetic field, is also incorrect. Moreover, all Wright's

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formulae are given in a form which is not suitable for direct comparison with experimental data. Rodot (Ref 3) obtained formulae for the longitudinal Nernst-Ettingshausen effect for degenerate semiconductors with scattering of electrons on the acoustical vibrations of the lattice and on impurity ions. Rodot's general formula for the Nernst-Ettingshausen effect in strong magnetic fields is incorrect; this can be seen from the special case of the non-degenerate electron state. Stimulated by inadequacies of earlier work, the present authors derived expressions for galvanomagnetic and thermomagnetic effects in degenerate semiconductors placed in very weak and very strong magnetic fields. It was assumed that
1) The current-carrier energy is proportional to the square of quasi-momentum ($\varepsilon = p^2/2m$);
2) the mean free path ℓ of current carriers is a power function of the energy ε ($\ell = a\varepsilon^r$, where r is arbitrary);
3) the current-carrier distribution is of the Fermi type

$$f_o = \left[\exp\left(\frac{\varepsilon - \mu}{kT}\right) + 1\right]^{-1}.$$

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The current-carrier mobility is then

$$u = \frac{\sqrt{2}e}{3\sqrt{m}} a(kT)^{r-\frac{1}{2}} (1 + r) \frac{F_r}{F_{1/2}},$$

and their concentration

$$N = \frac{4\pi}{h^3} (2mkT)^{3/2} F_{1/2}(\mu^*),$$

where $\mu^* = \frac{\mu}{kT}$ is the reduced chemical potential and

$$F_k(\mu^*) = \int_0^\infty \frac{x^k dx}{\exp(x - \mu^*)+1}$$

is the Fermi integral.

Expressions for all galvanomagnetic and thermomagnetic effects were obtained by means of the general formulae derived earlier by Bass and Tsidil'kovskiy (Refs 4,5). Formulae are given for:

The Effect of Current-Carrier Degeneracy on Transport Processes in Semiconductors

the transverse Nernst-Ettingshausen effect - weak magnetic fields (Eq 1 and Fig 1a), strong magnetic fields (Eq 2 and Fig 1b);
the Righi-Leduc effect - weak magnetic fields (Eq 3 and Table 1), strong magnetic fields (Eq 4 and Fig 2);
the longitudinal Nernst-Ettingshausen effect - weak magnetic fields (Eq 5 and Fig 3a), strong magnetic fields (Eq 6 and Fig 3b);
the electronic thermal conductivity - weak magnetic fields (Eq 7 and Fig 4a), strong magnetic fields (Eq 8 and Fig 4b);
the Hall effect - weak magnetic fields (Eq 9 and Fig 5), strong magnetic fields (Eq 10);
the Ettingshausen effect - weak magnetic fields (Eq 11 and Table 2), strong magnetic fields (Eq 12 and Fig 6);
the electrical conductivity - weak magnetic fields (Eq 13 and Fig 7a), strong magnetic fields (Eq 14 and Fig 7b).

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The paper is entirely theoretical.

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There are 7 figures, 2 tables and 5 references, 3 of which are Soviet, 1 English and 1 French.

ASSOCIATION: Institut fiziki metallov AN SSSR (Institute of Metal Physics, Ac. Sc., USSR)

SUBMITTED: December 4, 1958

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AUTHOR: Tsidil'kovskiy, I.M. SOV/126-8-4-2/22

TITLE: On the Scattering of Current Carriers in PbS-Group Compounds

PERIODICAL: Fizika metallov i metallovedeniye, Vol 8, Nr 4,1959, pp 494-502 (USSR)

ABSTRACT: PbS-type semiconductors can be used as infrared detectors and crystal amplifiers or detectors. These semiconductors, especially PbS, are usually assumed to have ionic structure (Refs 2-5). In the author's opinion physical properties of the PbS-type crystals show that covalent type of binding predominates over ionic binding in such crystals. The reasons for this view are discussed under the headings of 1) polarizability of the constituent ions, 2) lattice energy of PbS and PbSe, 3) static (χ) and optical ($\chi = n^2$) permittivities, and 4) current-carrier mobility. In ionic crystals the carrier mobility should decrease exponentially with temperature below the characteristic (Debye) temperature and should obey a power law: $u = u_o T^{-\frac{1}{2}}$. The experimental curve obtained for PbS by Dunayev and Maslokovets (Ref 10) obeys at all temperatures a power law: $u = u_o T^{-2.3}$. The same is

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true in the case of PbSe and PbTe, for which also $u \propto T^{-5/2}$ above 100 °K. Stil'bans et al (Refs 15,16) suggested that the $T^{-5/2}$ dependence is due to a multi-phonon mechanism of carrier scattering, whose probability rises with temperature. Experimentally the mechanism of carrier scattering can be found from measurements of thermomagnetic effects. Since carrier scattering varies with the type of binding, the latter can also be deduced from thermomagnetic measurements. Each mechanism of scattering is characterized by its own special dependence of the carrier relaxation time τ on temperature and energy: $\tau(T)$ and $\tau(\varepsilon)$. It is difficult and sometimes impossible to find the $\tau(T)$ dependence from thermomagnetic effects. The $\tau(\varepsilon)$ dependence affects strongly thermomagnetic phenomena, especially the Nernst-Ettingshausen effects. In weak magnetic fields, under isothermal conditions ($\partial T/\partial y = \partial T/\partial z = 0$) and when impurity conductivity prevails, the non-dimensional Nernst-Ettingshausen fields are given by:

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$$F_y = \frac{E_y}{\frac{k}{e}\frac{\partial T}{\partial x}} = \left(\frac{1}{2} - r\right) a_r \frac{uH}{c}, \qquad (1)$$

$$F_x = \frac{E_x}{\frac{k}{e}\frac{\partial T}{\partial x}} = (1 - 2r)\left(b_r - \frac{a_r^2}{2}\right)\left(\frac{uH}{c}\right)^2, \qquad (2)$$

where E_y and E_x are the electric fields in the y and x-directions (the temperature gradient is directed along the x-axis and the magnetic field H along the z-axis); the quantity r occurs in the dependence of the carrier relaxation time τ on energe ε:

$$\tau = \tau_0(T)\varepsilon^{r-\frac{1}{2}} ;$$

a_r and b_r are constants of the order of unity, which depend only on r. The author measured the transverse and longitudinal Nernst-Ettingshausen effects in PbS, PbSe and PbTe (some of the results were published earlier, cf Ref 21). The author considered also Putley's results (Ref 22) on the transverse effect in PbSe. The electrical properties of the samples at 300 °K

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(the electrical conductivity σ, the Hall constant R, the electron-density N, and the electron mobility u) are given in Table 1. The PbS, PbSe-1, PbS-2, PbTe-1 and PbTe-3 samples were polycrystals and PbSe-3, PbTe-2 were monocrystalline. The temperature coefficient of the electrical conductivity was positive in all samples in the impurity-conduction region. The intrinsic-conduction region began in PbSe-1 at $\sim$500 °K, in PbSe at $\sim$700 °K, and in PbTe at $\sim$ 380 °K; in the remaining samples conduction was mixed up to $\sim$750 °K. Figs 1-5 show the temperature dependences of the transverse Nernst-Ettingshausen effect of all the seven samples. Below $\sim$400 °K the transverse effect was positive in all samples, except in PbTe-3. The positive sign of the transverse effect indicates that r is less than $\frac{1}{2}$ (cf. Eq (1)). To find the value of r more precisely the longitudinal Nernst-Ettingshausen effect was measured; it was found that $r \cong 0$ for all samples, except PbTe-3. The results as a whole indicated that $r = 0$ at temperatures (below $\sim$ 400 °K) at which carriers interact with the lattice. The value $r = 0$

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indicates that carriers are scattered chiefly on acoustical vibrations, which in turn means that covalent-type of binding predominates in PbS, PbSe and PbTe. Knowing that $r = 0$ the carrier mobility can be calculated from the transverse Nernst-Ettingshausen effect in the region where $F_y > 0$. Such calculations showed that above 200-250 °K the hole and electron mobilities were proportional to $T^{-5/2}$, while at low temperatures these mobilities varied as T^{-1} - $T^{-1.8}$; in PbTe-3 the electron mobility varied as $T^{-5/2}$ up to 120 °K. These dependences agree qualitatively with the dependences obtained from the electrical conductivity and the Hall effect. The differences between the Hall and the Nernst-Ettingshausen mobilities are due to the stronger effect of the carrier-gas degeneracy on the Nernst-Ettingshausen effect, (all samples were degenerate at low temperatures). It was also found that the sign of the transverse Nernst-Ettingshausen effect in PbS was independent of the carrier sign. The fields F_y and F_x were found to rise on lowering of temperature; this shows that the impurity ions play a

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very small role (in spite of their high concentration, 10^{18}-10^{19} cm^{-3}) in scattering of current carriers at low temperatures.
There are 5 figures, 2 tables and 26 references, of which 13 are Soviet, 9 English, 3 translations from English into Russian, and 1 is German.

ASSOCIATION: Institut fiziki metallov AN SSSR
(Institute of Physics of Metals, Ac.Sc. USSR)

SUBMITTED: July 9, 1959